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CHROMOSOME NUMBERS IN SOME AMERICAN FARINOSE PRIMULAS WITH COMMENTS ON THEIR TAXONOMY[1]

H. W. VOGELMANN

The genus *Primula* presents interesting cytotaxonomic problems. Comprised of a number of both disputed and confusing species, the genus is a classical example of the utility of chromosome number determinations in elucidating species relationships. Bruun (1930, 1932) in an extensive cytological study of *Primula,* found that the subsection *Eu-Farinosae* is characterized by a basic number of $x = 9$ and that among its Eurasian species there occurred chromosome levels of 2x, 4x, 6x, 8x, and 14x. A separate subsection, proposed by Bruun (1932) on the basis of its cytological distinctness, includes several species with the basic number of $x = 8$.

The published data on the cytology of the American farinose primulas are scanty. And this has largely been obscured because reported chromosome number determinations for native species have been merely included in papers in which investigations other than cytological have been emphasized (Bruun, 1938; Thomas, 1951). It is my purpose here to summarize the available information as to chromosome counts for the American farinose species and to report my own cytological findings.

[1] Some of the data reported here are included in a dissertation entitled, "A Biosystematic Study of *Primula mistassinica* Michx.", which was submitted by the author to the University of Michigan in partial fulfillment of the requirements of the Degree of Doctor of Philosophy.

I am indebted to Drs. Doris and Askell Löve of the Botanical Institute of the University of Montreal for providing me with unpublished data. In particular I wish to express my appreciation to Dr. Askell Löve and Dr. Alexander Gershoy of the Botany Department of the University of Vermont for reading the manuscript and offering many helpful suggestions and comments.

SOURCE OF MATERIALS AND METHODS

The plants used for the present study were obtained either from germinated seeds taken from herbarium specimens or from living individuals transplanted to the greenhouse from their native habitat. All specimens were grown at the Botanical Garden of the University of Michigan during the years 1954 and 1955. This provided the opportunity to compare the morphological variations of plants in the greenhouse growing under uniform conditions which helped to interpret variations found in the field. Whenever plants found widely separated geographically, or plants within a particular population at a given site, showed obvious phenotypic differences these were carefully examined cytologically to determine whether correlated karyotypic differences also occurred. Voucher specimens were made of the experimental plants and these, together with the author's field collections are housed in the Pringle Herbarium of the University of Vermont.

Comparatively large collections were made of both *P. mistassinica* Michx. (including *P. intercedens* Fern.) and *P. laurentiana* Fern. Representatives of 16 populations of *P. mistassinica* covering much of its range in eastern North America were studied cytologically. Plants of *P. laurentiana* were also examined from collections taken from 9 stations in the Gaspé Peninsula and in Newfoundland.

Chromosome determinations were made mainly from root tips by use of the acetocarmine squash technique, after preliminary fixation in chloroform-ethanol-acetic acid (4:3:1).

OBSERVATIONS

Primula mistassinica Michx. is a widely distributed species in boreal North America found growing in a variety of calcareous habitats including wet sedgy or mossy sites, stony or marly lake shores, and on shaded wet ledges or faces of

cool bluffs. Root tip squashes from all plants investigated had a chromosome number of $2n = 18$ (Figs. 1-9). Table 1 shows the localities from which material was obtained. Chromosome numbers were constant regardless of geographical location or differences in habitat. Superficially the chromosomes appeared alike in size and shape in all plants examined.

Pronounced variation in leaf size, shape, and degree of farinosity was observed among the cultivated plants, this being particularly true for representatives from the Great Lakes region. Some individuals could well be assigned to *Primula intercedens* Fern., which Fernald (1928) described as endemic to the upper Great Lakes region. Selected plants showing extremes of all variations were carefully studied in an attempt to detect cytological differences and none was found.

The question of validity of *Primula intercedens* as a good species will be the subject of a forthcoming paper; however it is here advisable to make a few comments about this species in order to clarify its treatment in the present investigation. Fernald (1928) separated *Primula intercedens* from *Primula mistassinica* pointing out that the former had yellow-farinose leaves and calyces, and angulate, truncated, and strongly rugose seeds. According to Fernald, *Primula mistassinica* is generally efarinose with rounded and smooth seeds. Hesitant about the validity of his newly described species he adds (Fernald, 1928, p. 87), "*P. intercedens* is here proposed without full confidence of its specific value; but it seems most likely that, in the upper Great Lake region, where it occurs in the same areas as typical *P. mistassinica*, the two have become much crossed." Other taxonomists have indicated their difficulty in separating the two presumed taxa (Butters & Abbe 1953) and a few chose not to recognize the specific status of *P. intercedens* (Brown, 1937; Gleason, 1952). The present author's investigations based on field and transplanted populations, supplemented by herbarium specimens, fail to substantiate any consistent morphological differences between the two species. Since the present cytological study also fails to reveal karyological differences the present writer includes in the variable *P. mistassinica* complex the plants assigned to *P. intercedens*.

TABLE 1. Chromosome numbers of P. mistassinica

Species	*Locality*	*2n*
P. mistassinica Michx., var. mistassinica f. mistassinica (including P. intercedens Fern.)	MICHIGAN:	
	Cheboygan Co.: Grass Bay (Vogelmann 547 VT).	18
	Presque Isle Co.: Hammond Bay (Vogelmann 548 VT).	18
	Emmet Co.: Little Traverse Bay (Vogelmann 541 VT).	18
	Mackinac Co.: S. Gould City (Vogelmann 545 VT)	18
	Hog Island Creek (Vogelmann 544 VT)	18
	Davenport Creek (Vogelmann 546 VT)	18
	Alger Co.: Pictured Rocks (Vogelmann 549 VT)	18
	Miner's Falls (Vogelmann 533 VT)	18
P. mistassinica var. mistassinica f. leucantha Fern.	QUEBEC:	
	East Gaspé Co.: Percé (Vogelmann 654 VT)	18
	NOVA SCOTIA:	
	Victoria Co.: Cape North Village (Smith, et. al. 3750 MT)	18
	NEWFOUNDLAND:	
	St. Georges Port-Au-Port Distr.: Green Head (Rouleau 3709 MT)	18
	St. Barbe Distr.: Bonne Bay (Rouleau 3334 MT)	18
	Humber Distr.: Serpentine River (Rouleau 1865 MT)	18
	White Lake (Rouleau 2041 MT)	18
P. mistassinica var. noveboracensis Fern.	MICHIGAN:	
	Eaton Co.: Grand Ledge (Vogelmann 617 VT)	18
	NEW YORK:	
	Tompkins Co.: Taughannock Creek (Vogelmann 616 VT)	18

Primula laurentiana Fern., a quite robust species, is found in the Gaspé Peninsula, Newfoundland, and on the north shore of the St. Lawrence River where it usually grows on calcareous slopes or ledges. A list of localities from which specimens of *Primula laurentiana sensu str.* were obtained for chromosome counting is given in Table 2. The eight

populations studied, including transplants and plants grown from seeds, were octoploids, 2n = 72 (Fig. 10). Several meiotic figures, obtained from an anther squash of a plant from St. Barbe District, Newfoundland, showed good pairing (Fig. 13).

A single population, collected from "grassy talus slopes" between Chimney Cove and Shoal Point, in the Humber District of western Newfoundland, grown from seeds of plants collected by Dr. Ernest Rouleau (No. 3405), on deposit in the Marie-Victorin Herbarium of the University of Montreal, was found to have 2n = 54 (Fig. 11). Phenotypically these plants fell within the range of variation found in *P. laurentiana;* however, detailed examinations designed to clearly separate the "grassy talus" hexaploids from the groups of octoploids were not made in the present study.

TABLE 2. Chromosome numbers of P. laurentiana. s. str.

Species	*Locality*	*n*	*2n*
P. laurentiana Fern.	QUEBEC:		
	Rimouski Co.: Rimouski (Raymond and Kucyniak 1673 MT)		72
	West Gaspé Co.: Tourelles (Pere Louis-Marie and R. Cayouette 50183 MT)		72
	NEWFOUNDLAND:		
	St. Barbe Distr.: Bonne Bay (Rouleau 3320 MT)	36	72
	Humber Distr.: s. of Chimney Cove (Rouleau 1374 MT)		72
	n. e. of Serpentine River (Rouleau 1785 MT)		72
	s. w. of Black Head (Rouleau 1612 MT)		72
	Weebald (Rouleau 1576 MT)		72
	Big Island Cove (Rouleau 1300 MT)		72

Primula incana Jones. The widely ranging species, *Primula incana* Jones, is found growing in wet, calcareous, subalpine meadows of the Rocky Mountains. From transplants of *P. incana* collected in a wet meadow near Jefferson, Colorado, a definitive root tip chromosome count of 72 was obtained

(Fig. 14.) The chromosomes of this octoploid species appear slightly smaller than those found in octoploid *P. laurentiana* and decidedly smaller than those of the diploid *P. mistassinica.*

Primula specuicola Rydb. shows an unusual site preference within the arid regions of southeastern Utah and Arizona. Typically it inhabits the moist, shaded walls of shallow caves found in calcareous sandstone cliffs. Plants of this species are quite large, both upper and lower leaf surfaces being densely covered with whitish farina. Cytological studies indicate that it is a diploid.

The differences between the diploid *P. specuicola* and *P. mistassinica* emphasize striking dissimilarities in vegetative and floral structures. However, *P. specuicola* like *P. mistassinica* produces heterostyled flowers, a phenomenon which seems to be common among diploids but not polyploids of this section as stressed by Ernst (1953).

Primula hunnewellii Fern., described by Fernald (1934) from collections made on the limestone cliffs of the North Rim of the Grand Canyon, Coconino Co., Arizona, differed from *P. specuicola* in having a much smaller calyx and an exserted capsule. It is of interest that Kearney and Peebles (1942, p. 666) list it as a questionable synonym of *P. specuicola* stating that the "type of the doubtfully distinct *P. hunnewellii* also from the Grand Canyon". The present author's observations tend to support this interpretation since he found both exserted and included capsules among a number of plants from a single population near Bluff City, Utah (type locality for *P. specuicola*). The size of the calyces among these plants was variable, none being found as small as Fernald recorded for *P. hunnewellii.*

A summary of the known chromosome numbers in the North American farinose primulas is given in Table 3. Ernst (1953) has presented a chart showing the "ploid" levels for seven American species of the subsection *Eu-Farinosae* in which the Alaskan *Primula borealis* is given as a diploid, and *P. incana* is indicated as an octoploid. Bruun's cytological work is cited by Ernst as the basis for his list. Regrettably it is not clear to the present author whether the "n" counts which Bruun (1938, p. 252) gives in parentheses

after *P. mistassinica* and *P. laurentiana* are also intended to apply to those species which precede them in his listing.

TABLE 3. Chromosome numbers of some North American primulas in the subsection Eu-Farinosae

Species	*n*	*2n*	*Reported by*
P. borealis Duby		18	Thomas (1951)
P. incana Jones		72	Vogelmann
P. laurentiana Fern. s. lat.	36		Brunn (1938), Vogelmann
		72	Vogelmann
		54	Vogelmann
P. mistassinica Michx.	9		Bruun (1938)
var. mistassinica f. mistassinica (incl. P. intercedens Fern.)		18	Vogelmann
var. mistassinica f. leucantha Fern.		18	Vogelmann
var. noveboracensis Fern.		18	Vogelmann
P. specuicola Rydb.		18	Vogelmann
P. stricta Hornem. (det. on Swedish and Icelandic plants and from Churchill, Manitoba)		126	Bruun (1930, 1932) Löve and Löve (1956 and unpublished)

DISCUSSION

The widespread native diploid species, *P. mistassinica,* is considered here to be the North American counterpart of the widespread Eurasian diploid *P. farinosa.* This idea is given support not only by the chromosome number common to both species but also by the close phenotypic similarity to *P. farinosa* which exists among some of the plants in the variable *P. mistassinica* complex. Generally, plants of *P. mistassinica* are slender and efarinose yet some individuals, particularly those growing on calcareous sandstone ledges in the Great Lakes region, are difficult if not impossible to distinguish from certain plants of *P. farinosa.* Hybridization studies are needed to establish indices of crossability and fertility.

Where the northwestern range of *P. mistassinica* ends, the range of *P. borealis* begins (see maps in Hultén 1948, p. 1336). This Alaska and Yukon species has also proven to be diploid (Thomas, 1951). Even if these species are not

conspecific they are certainly closely related as is evidenced by phenotypic characters found in common and by chromosome morphology.

Phenotypic similarities between the octoploids *P. laurentiana* and *P. incana* have already been recognized (Hultén, 1948; Fernald, 1928). *P. scandinavica* of Europe, also an octoploid species, may well be a near relative of our North American taxa. Such herbarium specimens as have been available indicate similarities to *P. laurentiana.*

Still another octoploid, *P. decipiens,* grows in the southern cordillera in South America (Bruun, 1930, 1932). This species bears more similarity to *P. incana* of the Rocky Mountains than any other species, a fact noted by Fernald (1928, p. 74) who stated: "In its subcapitate inflorescence and plane bracts *P. incana* is nearer related to *P. decipiens* of southern South America (*P. magellanica* of authors) than to other members of the *Farinosae*". Bruun (1932) also points out that the chromosomes of the octoploid *P. decipiens* are three-fourths as long as *P. farinosa* which ratio is similar to the size relationship obtained by this writer in a comparison of *P. incana* and *P. mistassinica.* The smaller chromosome size of both *P. incana* and *P. decipiens* may be a further indication that both species differentiated from a common ancestral stock.

Although the diploids are widespread in Eurasia and North America, it appears that the octoploids and the tetrakaidekaploid (14-ploid) *P. stricta* have been most successful in establishing themselves throughout arctic and mountainous regions generally regarded as having severe environments (Stern 1949). The widespread recurrence of octoploid species, as for example *P. capitellata* in the alpine areas of southern Persia, *P. scandinavica* in Scandinavia,

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New York (8) 1455X and Grand Ledge, Michigan (9) 970X. FIG. 10. 72 chromosomes of *P. laurentiana* from Bonne Bay, Newfoundland. 1455X. FIG. 11. 54 chromosomes of *P. laurentiana* from between Shoal Point and Chimney Cove, Newfoundland. 1455X. FIG. 12. *P. specuicola* from near Bluff City, Utah. 970X. FIG. 13. 36 bivalents from pollen mother cells of *P. laurentiana* from Bonne Bay, Newfoundland. 970X. FIG. 14. 72 chromosomes of *P. incana* from Jefferson, Colorado. 970X. FIG. 15. *P. borealis,* 2n = 18, drawn from a root tip cross-section prepared by Dr. Henry J. Thompson and provided for publication by Dr. John H. Thomas.

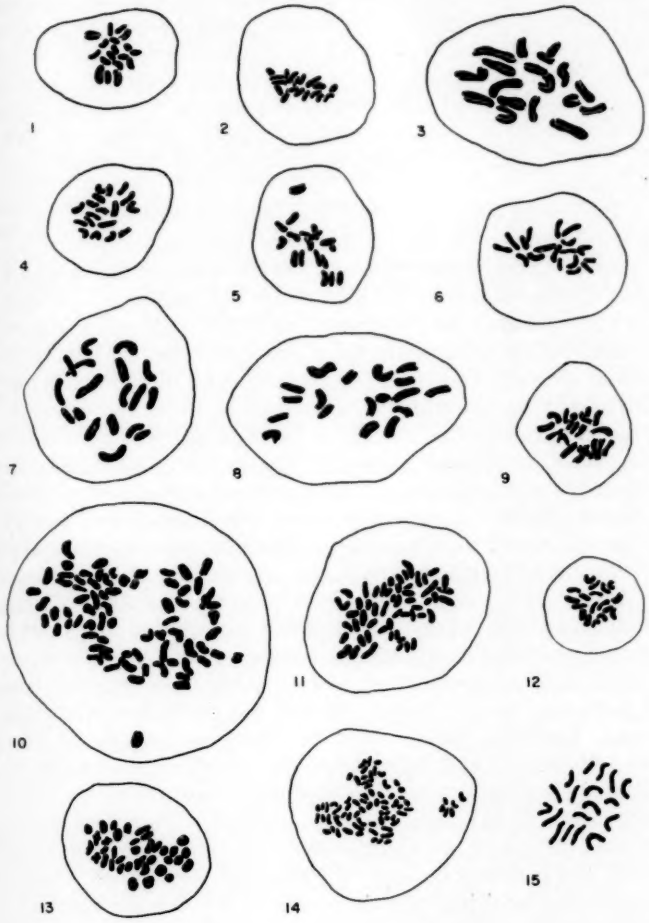

FIG. 1-14. Chromosomes of several North American primulas of the subsection *Eu-Farinosae*. All figures show root tip chromosomes at somatic metaphase unless otherwise indicated. FIG. 1. *P. mistassinica* from Grass Bay, Michigan. 1455X. FIG. 2. Chromosomes of an exceptionally large plant of *P. mistassinica* from Grass Bay, Michigan. 970X. FIG. 3-6. *P. mistassinica* f. *leucantha* from Newfoundland: Bonne Bay (3) 1455X; Serpentine River (4) 1455X; White Lake (5) 970X; Green Head (6) 1455X. FIG. 7. *P. mistassinica* f. *leucantha* from Cape North Village, Nova Scotia. 1455X. FIG. 8-9. *P. mistassinica* var. *noveboracensis* from Taughannock Creek,

P. laurentiana in Laborador, Nova Scotia, and the Gaspé, *P. incana* in the Rocky Mountains, and *P. decipiens* in the southern Andes, Cape Horn, and the Falkland Islands, may well be an indication of a very old and formerly highly successful complex. The present day discontinuous distribution of these species may, perhaps, indicate fragmentation of a formerly very wide-ranging species by Pleistocene glaciations.

The presence of a hexaploid plant in collections of *P. laurentiana*, sensu lat., in Newfoundland indicates that additional cytological studies are needed to determine whether this chromosome number, unique for this species, is of local or more widespread occurrence and whether there are morphological or ecological characteristics associated with it. When Bruun's (1930, 1932) investigation of the *Farinosae* revealed that the octoploid *P. scandinavica* (then called *P. scotica* var. *scandinavica*) was cytologically and geographically distinct from *P. scotica* (cf. also Dovaston, 1955), he observed dissimilarities in the leaves, scapes and stigmas (Bruun 1938). It should be noted that Smith and Fletcher (1943) are not convinced of the leaf and scape criteria used by Bruun although they do accept the validity of the species.

The relation of *P. specuicola* to other members of the farinose group is not clear. Since it is a diploid ($2n = 18$), and thereby holds a basic phyletic position, its taxonomic position deserves further investigation. The species does not appear to be closely related to any other American taxa. Rydberg (1913) suggests that it is near *P. farinosa* and *P. incana* and Fernald (1928, p. 86) states that "*P. specuicola* may be nearer related to *P. rusbyi* Greene ($2n = 44$, Bruun 1932) than to the *Farinosae*". The abundance of farina on the leaves and flowers of *P. specuicola*, combined with the fact that its basic chromosome number of 9, seems to fix the position of this species with the *Eu-Farinosae* complex.

P. specuicola is quite distinct from other species of the section in its ecological preference. Growing on moist calcareous sandstone walls of shallow caves in the arid regions of southwestern United States its habitat displays a striking contrast to that within which most members of the *Farinosae* are found. The latter are usually found at much

higher latitudes and/or altitudes where the macroclimate is considerably cooler and moist. Unquestionably *P. specuicola* is subjected to severe environmental fluctuations such as high temperatures and, perhaps, occasional periods of dryness.

The circumpolar and arctic species, *P. stricta* Hornem., has the highest number reported for the genus, or 2n = 126 chromosomes. This 14-ploid complement has been determined by Bruun (1932) on plants from two localities in Sweden and by Löve and Löve (1956) on material from northern and eastern Iceland. Populations from Churchill in Manitoba, collected and fixed by Dr. J. C. Ritchie of Winnipeg, were found to have the same high chromosome number (Löve and Löve, unpubl.) Thus there are good indications that this high chromosome level is maintained throughout its extensive arctic distribution.

The tendency toward polyploidy well-established among Eurasian species in primulas of the subsection *Eu-Farinosae*, is also revealed in the North American taxa. Thus chromosome levels of 2x, 6x, 8x, and 14x have been found within American species. In view of such data some revision is needed in the map of distribution of "ploid" levels in the *Eu-Farinosae* by Stern (1949), later used by Darlington 1956). The widespread occurrence of diploid and polyploid species in both hemispheres needs to be given serious consideration when evaluating the evolutionary development of the *Eu-Farinosae* complex. Of more general interest, the geographical patterns of "ploid" levels illustrated by this group may contribute to a better understanding of the history and distribution of the circumboreal flora. — UNIVERSITY OF VERMONT.

LITERATURE CITED

BROWN, CLAIR A. 1937. Ferns and flowering plants of Isle Royale, Michigan, 90 pp. U. S. Dept. Int.

BRUUN, H. G. 1930. The cytology of the genus *Primula*. (A preliminary report). Svensk Bot. Tidskr., **24**: 468-475.

———— 1932. Cytological studies in *Primula*, with special reference to the relation between the karyology and taxonomy of the genus. Symbolae Botanicae Upsalienses, **1**: 3-239.

———— 1938. Studies on heterostyled plants. 2. *Primula scandinavica* Nov. Sp., endemic in Scandinavia. Svensk Bot. Tidskr., **32**: 249-260.

BUTTERS, FRED K. AND ERNST C. ABBE, 1953. A floristic study of Cook County, Northeastern Minnesota, Rhodora **55**: 161-201.

DARLINGTON, C. D. 1956. Chromosome Botany. George Allen and Unwin Ltd., London. 186 pp.

DOVASTON, H. F. 1955. *Primula scotica* Hook. f. a relict species in Scotland. Notes, Roy. Bot. Gard. Edinb. **21**: 289-291.

ERNST, ALFRED. 1953. "Basic numbers" and Polyploidy und ihre Bedeutung für das Heterostylie-Problem. Archiv der Julius Klaus-Stiftung, **28**: 1-159.

FERNALD, M. L. 1928. *Primula* section *Farinosae* in America. Rhodora, **30**: 59-77, 85-104.

———— 1934. A new primula from the Grand Canyon of the Colorado. Rhodora, **36**: 117-118.

GLEASON, H. A. 1952. The new Britton and Brown illustrated flora of the Northeastern United States and adjacent Canada, Vol. 3, 589 pp. Lancaster Press, Inc., Lancaster, Penna.

HULTÉN, ERIC. 1948. Flora of Alaska and Yukon, VIII. Acta Univ. Lund, N. F. 2, Vol. 44, No. 1: 1203-1341.

KEARNEY, THOMAS H. AND ROBERT H. PEEBLES. 1942. Flowering plants and ferns of Arizona, U. S. D. A. Misc. Pub. No. 423, 1069 pp.

LÖVE, A. AND LÖVE, D. 1956. Cytotaxonomical conspectus of the Icelandic flora. Acta Horti Gotoburgensis, **20**: 65-291.

RYDBERG, P. A. 1913. Studies on the Rocky Mountain flora. XXIX. *Primulaceae*. Bull. of the Torrey Botanical Club, **40**: 461-462.

SMITH, W. WRIGHT, AND H. R. FLETCHER, 1943. The genus *Primula* section *Farinosae*. Trans. Royal Society Edinburgh, 61 (Pt. 1): 1-69.

STERN, F. C. 1949. Chromosome numbers and taxonomy. Proc. Linnean Soc. London, **160**: 119-125.

THOMAS, J. H. 1951. A collection of plants from Point Lay, Alaska. Contr. Dudley Herb. **4**:53-56.

THE STATUS OF THE GENERA AMPHIPAPPUS, AMPHIACHYRIS, GREENELLA, GUTIERREZIA, GYMNOSPERMA AND XANTHOCEPHALUM (COMPOSITAE)

OTTO T. SOLBRIG[1]

The taxonomic status of the genera *Amphipappus, Amphiachyris, Greenella, Gutierrezia, Gymnosperma* and *Xanthocephalum,* has been questioned recently by L. Shinners (1950). Since other authors (Torrey and Gray 1841, Bentham and Hooker 1873, Hoffmann 1890, Gray 1884, Rydberg 1917) have disagreed as to the treatment of these genera, it was thought to be of interest to reevaluate their position.

Previous investigations were based largely on superficial morphological observations. In attempting to treat the problem in a more objective fashion, a more detailed cytological and morphological study has been attempted. This has been by no means exhaustive, but the new data offer, in the author's opinion, sufficient information to delimit these genera satisfactorily.

CONCEPT OF GENUS AND ITS RELATIVE VALUE

To give a definition of a genus is as hard a problem as to try to define a species and no attempt will be made to solve this problem here. Nevertheless, a few considerations might be pertinent to the problem under consideration. They also will illustrate the author's ideas about these matters and the underlying principles of this work.

A genus is formed by a group of species which share a series of common properties. It is also related to other genera by some common properties, so as to allow us to place them in a particular tribe, subfamily or family. There is no fixed set of rules that determines which characters will be of "generic" and which of "specific" value, but we may say that if the common properties a group of species share are greater than the properties this group shares with another set of species (viz. another genus), we usually place these two groups of species in different genera. On the other

[1] Honorary travelling Fellow, University of California, and Botanist, Gray Herbarium, Harvard University. I am indebted to Dr. R. C. Rollins for suggestions and the reading of the manuscript.

hand if the species of the first group resemble those of the second group as much as each other, we usually place them in the same genus.

When the first case applies, that of a group of species resembling each other more than species of another group, we still might maintain them in the same genus, but in different subgenera or sections. This last procedure will be largely determined by the author's concept, and is therefore somewhat subjective. Also, it is likely to be influenced by the traditional usage in the family.

In the Compositae the tendency has been to erect many genera based on a few characters. The desirability of this could be disputed, but it has to a certain extent had a very practical basis. In a family as large and as homogeneous as this one, it is very hard to obtain a good understanding of large genera, e. g. *Senecio, Haplopappus, Baccharis, Solidago,* etc., while smaller groups (which are not necessarily always too small) can be better understood.

HISTORY OF THE GENERA UNDER STUDY

Xanthocephalum, with one species *X. centauroides,* was the first genus of this group to be described, in 1806, by Willdenow. The very brief description indicates only that the genus "belongs close to *Zoegea*"[2]

Lagasca (1816), in his original description of *Gutierrezia,* did not indicate its relationship to other genera. Nuttall (1818) indicated in his description of *Brachyris* (= *Gutierrezia*) the possesion of "vegetation almost similar to that of *Euthamia tenuifolia*". Both authors state that the involucre is formed by imbricated bracts, the heads are radiate, and the pappus paleaceous. However, all of these characters occur in several genera of Astereae, and therefore are not sufficient by themselves to define *Gutierrezia.*

The genus *Gymnosperma* was described by Lessing in 1819 based on *Selloa glutinosa* Spreng. Since *Selloa* H. B. K. a later name for another Mexican plant was conserved, *Selloa* Spreng. becomes a rejected name, and *Gymnosperma glutinosum* Less. is the correct name for the plant (Blake, 1930; Int. Rules Bot. Nom., Ap. III, Sect. X, 9168). Lessing states no relationships, other than the "undoubtedly asteraceous character" of the genus.

[2] "Eine zur Syngenesia frustranea gehörige Gattung, die bei *Zoegea* stehen muss".

De Candolle (1836) defines *Brachyris* Nutt. (= *Gutierrezia*) according to its habitat, the number of ligulate and tubular flowers, the form of the inflorescence, and the pappus, which is formed by well developed paleae of moderate size. He placed it near *Gymnosperma* Less., which has a pappus of very minute teeth, and *Hemiachyris* D. C., a genus with one species in De Candolle's conception, *H. texana*, which differs from *Gutierrezia* in having a pappus of short paleae in the tubular flowers and none in the ligulate ones.

Nuttall (1841) elevated *Amphiachyris*, considered by De Candolle to be a section of *Gutierrezia* (*Brachyris*), to generic rank. The principal justification was given as the following constellation of characters: "the involucrum obovate and bracteolate, scales few and obtuse not herbaceous at the points", and the "pappus of the discal florets united at base, dividing into about six entire setae. Radial florets with a very minute crown of scarcely visible setae".

Torrey and Gray (1841) accepted Nuttall's treatment of *Amphiachyris* but reduced *Hemiachyris* D. C., to become a section of *Gutierrezia*, a step which has been accepted by all later workers. They placed *Gutierrezia* next to *Gymnosperma* and *Amphiachyris*, from which it differs by the pappus characters already cited, and next to *Brachychaeta*, which differs from the above mentioned genera by its setiform pappus.

Bentham and Hooker adopted a more conservative attitude in the Genera Plantarum (1873). They merged both *Hemiachyris* and *Amphiachyris*, as well as the quite distinct genus *Amphipappus*, which had been described by Torrey and Gray in 1845 from material collected by Fremont in California, with *Gutierrezia*. This complex was then placed near *Gymnosperma* and *Xanthocephalum*, which differ from *Gutierrezia* in lacking a paleaceous pappus. In addition, *Gymnosperma* differs by its possession of minute ligules instead of well developed ones as in the other genera, and *Xanthocephalum* by its broad involucre. Also, *Grindelia* is considered to be very close, differing mainly in the shape of the involucre and involucral bracts.

In the Synoptical Flora (1884), Gray adopted a point of view close to that which he had held in 1841, the main difference being the transfer of *Amphipappus fremontii* into

Amphiachyris. Hoffmann's treatment (1890) for Engler's Pflanzenfamilien is similar to that of Bentham and Hooker (1873).

Most authors of local or regional floras in the United States have followed Gray's views as expressed in his Synoptical Flora. Exceptions to this are Rydberg's Flora of the Rocky Mountains (1917), in which this author restores *Amphiachyris fremontii* to *Amphipappus* T. & G.; and Blake (1924) who accepted *Amphipappus fremontii* but considers *Amphiachyris dracunculoides* to belong to *Gutierrezia.*

Porter (1943) reviewed *Amphipappus* and effectively established its status as a separate genus.

A radically different point of view has recently been adopted by Shinners (1950), who merges *Gutierrezia, Gymnosperma, Amphiachyris* (including *Amphipappus*), and the heterochromous *Greenella* Gray, all under *Xanthocephalum.* For Shinners, "the quite variable features of pappus, size of heads, and number of rays" do not constitute differences sufficient to justify the maintainance of separate genera.

CYTOLOGICAL AND MORPHOLOGICAL OBSERVATIONS

CYTOLOGICAL STUDIES. An attempt has been made to determine the basic chromosome numbers of as many species as possible of all the genera under consideration, as well as those of other more or less related genera in Astereae-Solidaginae. Part of these data have been published elsewhere (Raven, Solbrig, Kyhos and Snow, 1960) and part are presented here.

Table 1 shows the chromosome numbers of species of *Gutierrezia, Amphipappus, Amphiachyris, Xanthocephalum* and *Gymnosperma.* Unfortunately, only one species of *Xanthocephalum* and none of *Greenella* could be counted. Each of these genera studied proved to have a different basic chromosome number: four in *Gutierrezia,* five in *Amphiachyris,* six in *Xanthocephalum,* seven in *Gymnosperma* and nine in *Amphipappus.* The chromosome number thus proved to be an absolute distinguishing character between the genera. It can also be seen how the chromosome number con-

TABLE 1. CHROMOSOME NUMBERS

Species	n	2n	No. of counts	Reference
Amphiachyris dracunculoides	5	10	2	Solbrig, 1959
Amphipappus fremontii	9	—	2	Raven, Solbrig, Kyhos and Snow, 1960
Gutierrezia texana	4	—	3	Solbrig, 1959
Gutierrezia glutinosa	4	—	2	Solbrig, 1959
Gutierrezia serotina	4	—	1	Solbrig, 1959
Gutierrezia sarothrae	4, 8	8	20	Solbrig, 1959
Gutierrezia microcephala	8, 16	—	6	Solbrig, 1959
Gutierrezia bracteata	8, 12	16, 24	10	Solbrig, 1959
Gutierrezia californica	12	—	1	Solbrig, 1959
Gymnosperma glutinosum	7	—	1	Solbrig, 1959
Xanthocephalum gymnospermoides	6	12	2	Solbrig, 1959

firms *Gutierrezia (Hemiachyris) texana* as a true *Gutierrezia.*

MORPHOLOGICAL STUDIES. — **Involucre.** The shape of the involucre can be used in delimiting the genera under consideration, but it is not sufficient by itself in certain cases.

Gutierrezia possesses a characteristic elongate-turbinate involucre which varies from slightly campanulate in *G. glutinosa* and broadly turbinate in *G. texana* to narrowly elongate-turbinate in *G. microcephala.* The involucres of *Amphipappus* and *Gymnosperma* do not differ essentially from that of *Gutierrezia.* In contrast with them, *Xanthocephalum, Amphiachyris,* and *Greenella* have broadly campanulate involucres. Of these last three genera, *Amphiachyris* has an involucre most similar to that of *Gutierrezia glutinosa* to the point that in some cases only close observation

permits their separation on this basis. The involucre of *Xanthocephalum*, on the other hand, is quite different and very similar to that of *Grindelia*, a genus similar to *Xanthocephalum* in habit and chromosome number. *Greenella* possesses an almost hemispherical involucre, which may be easily distinguished from that of all species of these genera with the exception of *Gutierrezia glutinosa* and *Amphiachyris dracunculoides*.

Involucral bracts. There is little variation in the involucral bracts, whether within or between genera. The bracts are herbaceous with a hyaline margin and a dark green tip. The involucral bracts of *Xanthocephalum* are a little darker in color than those of the other genera.

Pappus. The characters of the pappus, which were used by the very first botanists in the study of these genera, are very valuable, although not necessarily absolute, criteria for delimiting them.

In order to use the pappus characters successfully one must consider the pappus of both ligulate and tubular flowers and the variation present in different species.

In fig. 1 are depicted pappus scales and bristles characteristic of the different genera under consideration. *Gutierrezia* has the most distinctive and characteristic pappus of the group. Both ligulate and tubular flowers have a well developed pappus formed by lanceolate paleae, with a slightly fimbriate margin. The paleae of the ligulate flowers are usually slightly shorter; in *G. texana* they are absent or very reduced, a characteristic used by De Candolle in establishing the genus *Hemiachyris*. The paleae are about the same size as the achene except in *G. texana* and *G. glutinosa*, where they are shorter than the achene. In no case are they longer than the corolla (for a detailed analysis of the variation of this character in *Gutierrezia*, see Solbrig, 1959).

Amphipappus has numerous, linear, toothed, pappus-setae, which are slightly longer than the tubular corollas. They are sufficiently distinct to characterize the genus, as already noted by Asa Gray (1873). *Gymnosperma* and *Greenella* are similar in possessing a reduced crown of minute scales instead of a well developed pappus, in both ligulate and tubular corollas.

Xanthocephalum usually has only a low rim or crown in both ligulate and tubular corollas. It is not uncommon, however, to find in some or all of the tubular flowers of every species, one to three elongated, triangular-shaped, irregular awns.

Amphiachyris usually has no pappus at all in the ligulate flowers, or only a low, scaly ring. However, the tubular corollas, possess a pappus of few, ephemeral, dilated bristles

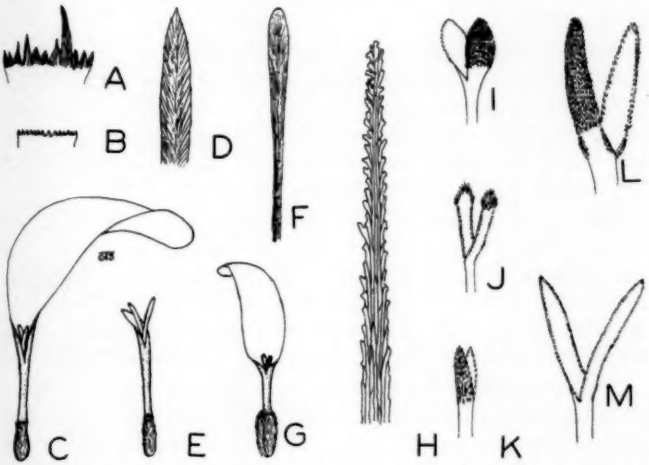

FIG. 1. *Xanthocephalum gymnospermoides: A.* Pappus × 5; *J.* Style of tubular flower × 16. *Xanthocephalum wrightii: C.* Ligulate flower × 2. *Gymnosperma glutinosum: B.* Pappus × 5; *E.* Ligulate flower × 2. *Gutierrezia sarothrae: D.* Pappus bristle × 5; *L.* Style tubular flower × 16. *Amphiachyris dracunculoides: F.* Pappus bristle × 5; *K.* Style tubular flower × 8. *Amphipappus fremontii: G.* Ligulate flower × 2; *H.* Pappus bristle × 5; *I.* Style tubular flower × 8; *M.* Style ligulate flower × 16.

which are fused at the base. There is some variation, with the bristles sometimes broad enough to resemble the characteristic paleae of *Gutierrezia.* This resemblance is nevertheless more apparent than real.

Corolla. The tubular corollas are essentially alike. The ligulate corollas manifest some significant differences in a few instances.

Gymnosperma has ray flowers with ligules which do not surpass the tubular corollas. In all the other genera the ray

corollas are bigger than the tubular ones. The ligules of *Xanthocephalum* are larger and more numerous than those of the other genera. *Greenella* is the only genus of the group with white ligules, all the other genera having yellow ones.

Anthers and pollen. The anthers are essentially alike in all the genera under consideration. Their shape is characteristically asteraceous, with a blunt base and a more or less triangular, rounded connective. The pollen is also very uniform in all the genera and is also of the characteristic type for the tribe.

Styles. The variation in styles is not very great from genus to genus; nevertheless, in certain cases the differences are significant enough to deserve attention, especially since classical synantherologists have attributed so much importance to characters of the styles in the delimitation of tribes and genera of Compositae (Bentham 1873).

The styles of the female ray flowers are different from those of the hermaphrodite tubular ones. We find in the ray flowers a style composed of two elongated branches, gradually attenuated toward the tip and with a border of papillae along both sides of the stigmatic branches. This situation holds true for all the genera considered here.

The branches of the style of the tubular flowers are shorter than those of the ligulate ones. In addition, instead of having the stigmatic papillae all around the border of the two stigmatic branches, they are confined to the lower quarter on both sides. Finally, both external sides of the stigmatic branches are covered with collecting hairs.

The collecting hairs may be well developed and pointed as in *Gutierrezia, Xanthocephalum, Greenella,* and *Amphiachyris,* or they may be slightly smaller and with rounded tips as in *Amphipappus* and *Gymnosperma.* These two genera also have elliptic rather than subulate style branches.

Stigmatic papillae are totally lacking in the tubular flowers of *Amphipappus fremontii* and *Gutierrezia microcephala.* In *Xanthocephalum gymnospermoides* the papillae extend beyond the middle of the stigmatic branches, while the collecting hairs are restricted to the upper part of the style (fig. 1). These variations have, nevertheless, only specific value.

TABLE 2. PRINCIPAL DIFFERENTIATING CHARACTERS

	GUTIERREZIA	AMPHIACHYRIS	XANTHOCEPHALUM	GYMNOSPERMA	AMPHIPAPPUS	GREENELLA
Basic chromosome no.	4	5	6	7	9	
Involucre	turbinate	campanulate	campanulate	turbinate	turbinate	campanulate
Pappus ligulate fl.	palene	minute	minute	minute	minute	minute
Pappus tubular fl.	palene	setae	minute and or squamellae	minute	setiform palene	minute
Ligules	less than 15 medium-sized yellow	10 to 20 medium-sized yellow	more than 20 large yellow	less than 10 very short yellow	less than 10 medium-sized yellow	10 to 20 medium-sized white
Stigma branches	subulate	subulate	subulate	elliptic	elliptic	subulate
Collecting hairs	pointed	pointed	pointed	blunt	blunt	pointed
Habit	perennial or annual	annual	annual	perennial	perennial	perennial or annual
Blooming time	Fall	Fall	Fall	Fall	Spring	Fall

HABIT AND DISTRIBUTION

Amphipappus is the only spring-blooming genus of the group. It is a suffrutescent perennial shrub restricted to the regions of the Colorado River basin in southern Utah, Nevada and South-east California (Porter, 1943). The author's observations on one population near Shoshone, California, show that leaves and small branches die out entirely during the dry season. Unfortunately, this condition could not be confirmed for plants in the greenhouse, since they died shortly after blooming.

Xanthocephalum is a genus of annual, fall blooming plants, mostly from central Mexico (Matuda, 1958). Two species, *Xanthocephalum gymnospermoides* and *X. wrightii*, reach the mountains of southern Arizona and New Mexico, growing at elevations of 800 to 2,500 meters.

The number of species of *Greenella* is probably three. They are also mainly Mexican, growing on Cedros Island, Baja California, and in northern mainland Mexico and southern Arizona. They are perennial, fall-blooming plants, with the exception of the annual *G. arizonica*.

Gymnosperma glutinosum, the only member of the genus, ranges from northern Guatemala to Arizona, New Mexico and Texas. It is also perennial and fall-blooming.

Amphiachyris, as here delimited, has two species, *Amphiachyris dracunculoides* (DC.) Nutt., and *Amphiachyris amoenum* (Shinners) Solbrig[3]. Of these two annual, fall-bloomers, *A. dracunculoides* has apparently spread from its native habitat in Oklahoma and Texas throughout the dry parts of the Great Plains as far north as Kansas and Illinois and eastward into Kentucky and Louisiana. Nevertheless, it is considered to be a weed of only secondary importance. *Amphiachyris amoenum*, on the other hand is not common, being restricted to limestone soils of the Grand Prairie and eastern Edwards Plateau (Shinners, 1951).

Gutierrezia is the most widely distributed of this group of genera. It is found in western and central North America scattered in dry and rocky areas west of the central plains and reaching from Alberta and British Columbia in the north, to San Luis Potosi, Mexico, in the south. It is also

[3] *Amphiachyris amoenum* (Shinners) comb. nov., based on *Xanthocephalum amoenum* Shinners Field and Lab. 19: 77, 1951.

found in South America, namely in south western Bolivia, northwestern Argentina and northern Chile. It prefers loose, sandy soils. The species are either globose perennial shrubs or stout annuals, these latter being restricted to northeastern Mexico, New Mexico, Texas and Oklahoma (Solbrig, 1959).

KEY TO THE GENERA

A. Ray corollas equaling or shorter than the tubular corollas ..... 1. GYMNOSPERMA.

AA. Ray corollas longer than tubular corollas.

B. Pappus of both ligulate and tubular flowers composed of several well developed paleae (lacking in the ray of *G. texana*) ..... 2. GUTIERREZIA.

BB. Pappus of both ligulate and tubular flowers composed of setae, or low toothed crown, or lacking.

C. Involucre turbinate, appressed; perennial spring-blooming shrubs ..... 3. AMPHIPAPPUS.

CC. Involucre campanulate; perennial or annual fall-blooming shrubs or herbs.

D. Perennial (Except *G. arizonica*); ligules white ..... 4. GREENELLA.

DD. Annuals; ligules yellow.

E. Rays more than 20; pappus of tubular flowers reduced to a crown of minute scales or with 2 or 3 squamellae ..... 5. XANTHOCEPHALUM.

EE. Rays less than 20; pappus of tubular flowers of few ephemeral setae fused at base ..... 6. AMPHIACHYRIS.

— GRAY HERBARIUM, HARVARD UNIVERSITY.

LITERATURE CITED

BENTHAM, G., 1873. Notes on the classification, history and geographic distribution of Compositae. Journ. Linn. Soc. Bot. **13**: 335-577.

————, AND J. D. HOOKER, 1873. Genera Plantarum, Vol. 2(1), 553 pp., London.

BLAKE, S. F., 1924. New American Asteraceae. Contr. U. S. Nat. Herb., **22**: 587-661.

————, 1930. Notes on Certain Type Specimens of American Asteraceae in European Herbaria. Contr. U. S. Nat. Herb. **26**(5): 227-263.

DE CANDOLLE, A., 1836. Prodromus Systematis Naturalis. Vol. 5, 706 pp., Paris.

GRAY, A., 1873. Notes on Compositae and Characters of certain Genera and Species, etc., Proc. Am. Ac. **8**: 631-661.

————, 1884. Synoptical Flora of North America. Vol. 1(2), 480 pp. New York.

HOFFMANN, O., 1890. Compositae. In Engler, A. and K. Prantl, Die Natürlichen Pflanzenfamilien, 4(5): 87-394.

LAGASCA, M., 1816. Genera et Species Plantarum quae aut novae sunt. 35 pp. Madrid.

MATUDA, E., 1958. Las Compuestas del Estado de Mexico. 114 pp. Toluca.

NUTTALL, T., 1818. The genera of North American Plants and a catalogue of the species to the year 1817. Vol. 2, 254 pp. Philadelphia.

————, 1841. Descriptions of new species and genera of plants in the natural order of Compositae. Trans. Amer. Phil. Soc. (n. s.) 7: 283-453.

PORTER, C. L., 1943. The genus Amphipappus T. & G. Amer. Jour. Bot. **30**: 481-483, 1943.

RAVEN, P., O. T. SOLBRIG, D. KYHOS AND D. SNOW, 1960. Chromosome Numbers in Compositae. I. Astereae. Amer. Jour. Bot. **47** (2). (in press).

RYDBERG, A., 1917. Flora of the Rocky Mountains and adjacent plains. 1110 pp. New York.

SHINNERS, L., 1950. Notes on Texas Compositae IV. Field and Lab. **18**: 25-32.

————, 1951. Notes on Texas Compositae VII. Field and Lab. **19**(1): 74-82.

SOLBRIG, O. T., 1959. Cytotaxonomical and Evolutionary Studies in the genus Gutierrezia (Compositae). Ph.D. Thesis. Univ. Calif., Berkeley, 160 pp.

TORREY, J. AND A. GRAY, 1841-43. Flora of North America. Vol. 2, 504 pp. New York.

———— AND ————, 1845. Amphipappus, Torr. & Gray, ined. Boston Journ. Nat. Hist. 5: 107-108.

WILLDENOW, C. L., 1807. Einige Bemerkungen über die Pflanzen der Klasse Syngenesia. Ges. Naturf. Fr. Berlin, Mag. 1: 132-141.

SOME SISYMBRIUMS (CRUCIFERAE) NATIVE TO TEXAS AND NORTHEASTERN MEXICO

REED C. ROLLINS

The very close relationship of certain species of *Romanschulzia* to *Sisymbrium* has been recognized from the time of the founding of the former genus. In fact, it was established upon species then considered to belong to *Sisymbrium*. More recently (1956, 1957) I have been faced with the problem of species placement in the borderline area between the two genera. In general, *Romanschulzia* is characterized by having flowers with exserted, spreading stamens that are nearly equal in length, and by siliques borne on a definite gynophore. In several of the species, the calyx is calyptrate, being shed by the expanding anthers at anthesis. In addition, the cauline leaves are strongly auriculate and they are markedly differentiated from the basal leaves when present, which are petiolate. But some species of *Sisymbrium* have strongly auriculate cauline leaves and the basal leaves are more or less petiolate. So the line between these two genera, as with many other pairs or groups of genera in the *Cruciferae*, is a very tenuous one in certain boundary areas between them.

Several species of auriculate-leaved Sisymbriums of northeastern Mexico and extreme western Texas are of interest, not only because of their impingement on *Romanschulzia* but because only recently have we obtained sufficient material to provide an adequate basis for careful study. The problems posed by these materials range from nomenclatural ones to the accurate assessment and characterization of some little known or undescribed species. The first problem, touched on briefly by M. C. Johnston (1957), needs careful treatment because of the related species I wish to discuss and define.

Sisymbrium Vaseyi Watson in Robinson, Syn. Fl. N. Am. 1: 138. 1895.

In a curious treatment of this name, Payson (1922) listed it as a synonym of his newly proposed *Sisymbrium Watsonii*, at the same time attempting to produce a new *Sisymbrium*

Vaseyi based on *Thelypodium Vaseyi* Coulter. Such a transfer could not be legally made because of the preoccupation of the name in *Sisymbrium* by *S. Vaseyi* Watson. The result of Payson's action was that he proposed a new name for the wrong species. The name *Sisymbrium Vaseyi* Watson is legal in every respect, and the type, collected by G. R. Vasey in Las Vegas, New Mexico, in 1881, is in the Gray Herbarium. A second specimen, with the locality given as "mts. west of Las Vegas, N. Mex., *G. R. Vasey 41*, 1881" may possibly be part of the same collection, but this is not a certainty. This second collection, if it be that, is one of the two collections cited by Coulter (see below) when he described *Thelypodium Vaseyi*. Whether Watson's type was the same collection as that cited by Coulter is immaterial in the present problem because the two collections cited by Coulter, one by Vasey and the other by Nealley, belong to two different species. It is clear that Watson's intention was to describe a new species, for "n. sp." is written in his own hand after "Sisymbrium (?) Vaseyi" on the label of the holotype. The effect of Robinson's action in publishing Watson's name, *Sisymbrium Vaseyi*, was to restrict the application of the name *Thelypodium Vaseyi* Coulter to the species represented by the Nealley specimen, which became the type, since Coulter had not himself chosen a type for the name. Robinson, as author of the treatise on *Sisymbrium* in the Synoptical Flora, was the one who supplied notes and a description for Watson's name and there was no confusion in his treatment whatever.

Sisymbrium Vaseyi Watson is so far known only from New Mexico. I think Johnston's (l. c.) statement that it is Mexican must have been a slip. The species associated with the name *Thelypodium Vaseyi* has been known from extreme southwestern Texas and now has turned up in Tamaulipas, Mexico. It must now be known by the following name:

Sisymbrium Shinnersii M. C. Johnston,
Southwestern Nat. **2**: 129. 1957.

Based on *Thelypodium Vaseyi* Coulter, Contrib. U. S. Nat. Herb. **1**: 30. 1890; not *Sisymbrium Vaseyi* Watson.

Coulter cited two collections following the description of

FIG. 1, A-E. Sisymbrium Shinnersii M. C. Johnston. A — habit sketch × 1/3; B — flower with stamen and petal removed × 3; C — silique and pedicel × 1; D — replum showing funiculi × 1; E — seeds, surface and sectional views, × 3. Drawings by C. S. Tsao.

T. Vaseyi: "near Rio Grande City, Texas (Nealley); also collected in 1881 by G. R. Vasey (No. 29) in the mountains west of Las Vegas, New Mexico, in immature condition." Coulter further states, "Vasey's plants were too young to be characterized, although Mr. Watson, to whom the specimens were submitted, considered them as probably representing a new species. Mr. Nealley's specimens supply nearly mature pods, which may become longer than noted in the description." When this evidence is added to the fact that Coulter's paper is entitled, "Upon a collection of plants made by Mr. G. C. Nealley, in the region of the Rio Grande, in Texas, from Brazos Santiago to El Paso County", it is clear that the type of *Thelypodium Vaseyi* is, and ought to be, the Nealley specimen.

Johnston's short note proposing the new name *Sisymbrium Shinnersii* gave one new citation, that of *Runyon 3788*, in addition to those of Payson (l. c.). We now have the following recent collections to report that amplify and extend considerably the previously known range of this species. TEXAS: Cameron County, 6 miles northeast of Olmito, April 20, 1959, *Rollins and Correll 5953* (GH, LL); 3 miles northwest of Russelltown, near San Benito, April 20, 1959, *Rollins and Correll 5954* (GH, LL); Arroyo Colorado, just south of Harlingen, April 21, 1959, *Rollins and Correll 5956* (GH, LL); Barreda Tract, Barreda, April 11, 1941, *Runyon 2521* (GH). MEXICO: Tamaulipas, region of Rancho Las Yucas, ca. 40 km. nnw. of Aldama, Municipio de Aldama, July 25, 1957, *R. L. Dressler 2014* (GH); same locality, October 16, 1957, *R. L. Dressler 2427* (GH). *S. Shinnersii* is illustrated in fig. 1.

Sisymbrium arcuatum Rollins, sp. nov.

Annual; stem single from base, erect, weak, usually branched at each node, occasionally simple, glabrous, 5-10 dm. high; leaves all sessile and auriculate, entire, lower nearly pandurate, gradually becoming ovate to broadly oblong upward, glaucous beneath, greenish above, 2-8 cm. long, 1-4 cm. wide; inflorescences terminating each branch lax and much elongated; sepals purplish, glabrous, narrowly oblong, nonsaccate, 3-4 mm. long, ca. 1 mm. wide; petals white, spatulate with a slender claw, 5-6 mm. long, ca. 2 mm. wide; filaments not swollen at base, 3-4 mm. long; filaments of single stamens not appreciably shorter than those of paired stamens; anthers purplish, ca. 2 mm. long; siliques terete, slender, sessile, widely spreading, becoming somewhat pendulous, slightly arched downward to nearly straight, 1-3-

nerved, 8-10 cm. long, about 1 mm. in diameter; styles 1-1.5 mm. long; stigmas unexpanded; pedicels spreading to slightly recurved, 8-11 mm. long, slightly expanded at summit; seeds immature, wingless, oblong.

Herba annua; caulibus erectis vel cernuis ramosis glabris 5-10 dm. altis; foliis sessilibus amplexicaulibus auriculatis integris glabris 2-8 cm. longis, 1-4 cm. latis, inferne panduratis vel ovatis, superne ovatis vel late oblongis; sepalis purpureis nonsaccatis anguste oblongis 3-4 mm. longis; petalis albis spathulatis 5-6 mm. longis; pedicellis fructiferis patentibus tenuibus glabris 8-11 mm. longis; siliquis sessilibus anguste linearibus teretibus patentibus vel late pendulis plus minusve arcuatis 8-10 cm. longis, ca. 1 mm. in diametro; stylis 1-1.5 mm. longis; seminibus immaturis oblongis immarginatis.

Type in the Gray Herbarium collected on a slope in open pinyon forest, 1-2 miles southwest of Pablillo, Nuevo León, Mexico, July 21, 1958, *D. S. Correll and I. M. Johnston 19941*. Isotype in the Lundell Herbarium, Texas Research Foundation.

Sisymbrium arcuatum is nearest related to *S. Shinnersii*. From the latter, it differs in having much longer, arcuate and widely spreading more or less pendulous siliques and somewhat pandurate lower leaves. In *S. Shinnersii*, the siliques are divaricately ascending, straight and with a maximum length of about 6 cm. instead of 10 cm. as in *S. arcuatum*. In the latter species, the pedicels are widely spreading and somewhat arched downward, whereas in *S. Shinnersii*, the pedicels are rigidly divaricate, straight and always ascending. Both species have very slender siliques.

Sisymbrium Purpusii (Brandegee) O. E. Schulz, Pflanzenr. 86, (IV, 105) 58. 1924.

Based on *Thelypodium Purpusii* Brandegee, Zoe 5: 232. 1906.

Annual; stems single from the base, erect, branched at nearly every node; glabrous, leafy, 3-7 dm. high; branches ascending, dense; lower leaves sinuate-dentate to somewhat lobed, thin, glabrous, with a broad and conspicuous central vein, petiolate, oblanceolate, obtuse, 6-15 cm. long, 1-3 cm. wide, petiole winged; cauline leaves becoming sessile and auriculate, sparsely dentate to entire, middle and upper leaves lanceolate and amplexicaule; sepals greenish, oblong, scarious-margined, nonsaccate, glabrous, 3-3.5 mm. long, ca. 1 mm. wide; petals spatulate, with a slender claw, white, 4-5 mm. long, ca. 1.5 mm. wide; filaments of single stamens markedly shorter than those of the paired stamens, filaments of paired stamens 3-4 mm. long; anthers oval, less than 1 mm. long; pedicels slender, divaricately ascending to nearly erect, straight, glabrous, 1-1.5 cm. long; immature siliques narrowly linear, terete, straight, ascending, 4-7 cm. long, ca. 1 mm. in diameter; styles ca. 1 mm. long.

The above amplified description of *S. Purpusii* takes new-

ly found Texas specimens into account. This Texas material is the first from the United States and the only specimens I have seen other than the two Purpus collections cited by Brandegee at the time the species was proposed. Dr. M. C. Johnston informs me that the place of collection, as indicated below, is relatively inaccessible. The following numbers are in the Gray Herbarium: *M. C. Johnston and B. H. Warnock 3734, 3735 and 3736*, all collected at an altitude of 3,300 ft. in different habitats on the McCormick Ranch, small lateral canyon southwest of Old Smith Ranch, near Fresno Canyon, Presidio County, Texas, March 1, 1959.

Sisymbrium Purpusii is in the general alliance of *S. Shinnersii* and *S. arcuatum* but the species is not closely related to either of them. In particular, the leaves are of a different shape and texture. The plants of *S. Purpusii* tend to be leafy and the branching is often rather virgate with the branches markedly ascending. The considerably elongated lower leaves are petioled and sinuate to somewhat lobed in contrast to the sessile and auriculate comparable lower leaves of both *S. Shinnersii and S. arcuatum.* In none of these species is there a strictly basal rosette. The nearest approach to this is in *S. Purpusii* in particular plants that grow slowly at first, producing short internodes between the leaves. But in such instances the leaves are merely crowded and the leaf arrangement is not a rosette in the usual sense.

The anthers of *S. Purpusii* are oval and less than half as long as those of either *S. arcuatum* or *S. Shinnersii* where the anthers are oblong in shape. The nearest relative of *S. Purpusii* is *S. Kearneyi*, a species at present known only from the Grand Canyon of Arizona. — GRAY HERBARIUM OF HARVARD UNIVERSITY.

LITERATURE CITED

JOHNSTON, M. C. 1957. Sisymbrium Shinnersii. Southw. Nat. 2: 129.

PAYSON, E. B. 1922. Species of Sisymbrium Native to America North of Mexico. Univ. Wyo. Publ. 1: 1-27.

ROLLINS, R. C. 1956. Some New Primitive Mexican Cruciferae. Rhodora 58: 148-157.

———, 1957. Miscellaneous Cruciferae of Mexico and Western Texas. Rhodora 59: 61-71.

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